

## Description of the last stadium larvae of *Argia medullaris* Hagen in Selys and *A. variegata* Förster (Odonata: Coenagrionidae)

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Detailed descriptions and illustrations are provided of the ultimate instar larvae of *Argia medullaris* and *Argia variegata* from Colombia. The principal features are outlined and compared with other species. *Argia medullaris* differs from other species of the genus by the parallel width of the lateral gills and prominent ligula; the *A. variegata* larva can be separated from other species by the absence of setae and spines on male and female gonapophyses and its peculiar madicolous habit.

**Keywords:** Zygoptera; Coenagrionidae; *Argia*; madicolous; PNN Tatamá; Colombia; larvae

### Introduction

*Argia* Rambur is the most speciose genus of the Zygoptera with about 112 species described for the Neotropical region (Garrison et al., 2010). A high potential for the discovery of new species exists. Larvae of only 40 species (36%) have been described (Garrison et al., 2010), most of them by Novelo-Gutiérrez (1992) and Westfall & May (2006). Despite being common to abundant damselflies in lotic environments, progress in documenting their larvae has been slow (Novelo-Gutiérrez, 2008); approximately half have been described within the last 10 years. The Colombian checklist now includes 20 species (Pérez & Palacino, 2011). Here we describe and illustrate the previously unknown last stadium larvae of *A. medullaris* Hagen and *A. variegata* Förster.

### Materials and methods

Confirmation of the species was made by examining the pharate cercus of males. All larvae were preserved in ethanol (80%). Drawings were made using a stereoscope Wild M8, coupled with a camera lucida. Terminology follows Westfall and May (1996) for body characters and Watson

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(1956) for mandibular formulae. Measurements (mm) were made with a calibrated ocular micrometer at various magnifications. Total length excludes caudal gills; gill length excludes the filament and length of head excludes the labrum, maximum transverse width of the head was measured across the compound eyes and maximum length (anterior to posterior) along the middle line.

### *Argia medullaris* Hagen in Selys, 1865

Figure 1a–l

#### Material examined

One exuvia (1♂, reared), two F0 larva (1♀ and 1♂). COLOMBIA: Risaralda; Municipality of Santuario, vía centro de visitantes km 6 Parque Nacional Natural (PNN) Tatamá. Rio San Rafael,

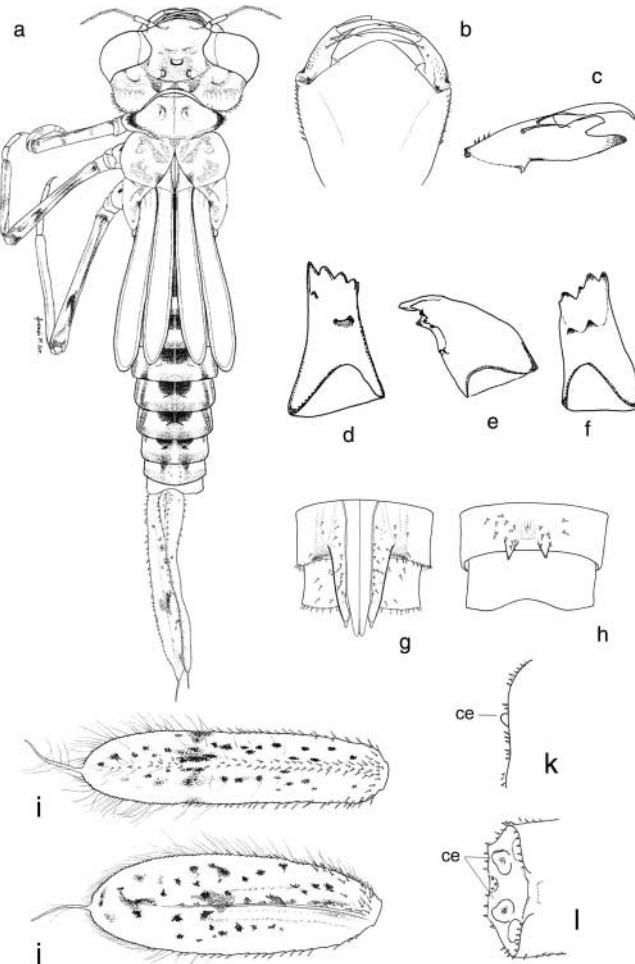


Figure 1. Details of morphology of the larva of *Argia medullaris*. (a) Dorsal aspect of F0 larva (right gill detached); (b) labium; (c) right labial palp, male, dorsal view; (d) right mandible, ventral view; (e) right mandible, lateral view; (f) left mandible, ventral view; (g) abdominal segment 9–10 showing female gonapophyses; (h) abdominal segment 9–10 showing male gonapophyses; (i) tip of male abdomen showing cercus (gills detached), left lateral view; (j) tip of male abdomen showing gonapophyses and cercus (gills detached) ventroposterior view; (k) left gill, lateral view; (l) middle gill, lateral view (ce = cercus).

5° 12' N 76° 04' W, 2100 m, 20 June 2010. L. Pérez leg. Deposited at Universidad del Atlántico Región Caribe (UARC), Barranquilla, Atlántico, Colombia.

### Description

Larvae amber with a distinctive pattern of dark spots on abdominal segments, femora and gills.

**Head.** 1.46 times as wide as long, posterior margin deeply excavated. Brown with pale spots on posterior margin of compound eyes. Cephalic lobes rounded, posterolateral margins bearing 9–14 spiniform setae. Labrum setose, brown, clypeus smooth, brown. Antenna 7-segmented, yellow, slightly longer than head; length ratio of antennomeres (basal to apical): 0.34: 0.70: 1.0: 0.59: 0.4: 0.3: 0.19 (Figure 1a). Mandibles with molar teeth but lacking molar crest, with following formula:  $L\ 1 + 2345\ 0\ ab\ (4 > 5 > 2 > 3 > 1)/R\ 1 + 2345\ y\ ab\ (5 > 4 > 3 > 2 > 1)$ , in both mandibles  $b > a$  (Figure 1d–f). Labium short, ovoid and pale; hinge extending to anterior margin of mesocoxae, prementum 0.87 times as wide as long (Figure 1b) with row of 14 spiniform setae along distal half of lateral margins. Ligula prominent and wide; with closely set minute, claviform setae on distal margin. Labial palp with 2 end hooks shorter than movable hook, the ventral one the longer (Figure 1c). Palp with 2 or 2 + 1 long setae basal to movable hook, and row of 4 short, stout, claviform setae basal to premental insertion.

**Thorax.** With distinctive color pattern. Middle lobe of prothorax with semicircle of dark spots. Pronotal disc smooth, lateral margins strongly convex, dark and covered with spiniform setae, pterothorax robust and smooth. Mesepisternum with two lateral dark spots, mesepimeron with three stripes, the posterior darkest. Wing sheaths amber; anterior pair reaching basal half of S5, posterior pair reaching to posterior margin of S5. Legs yellow, with irregular dark spots on femora proximal to trochanter insertion, in middle region along dorsal carina, and proximal to tibia insertion, faint spots on tibiae with pattern nearly like femora (Figure 1a). Femora flattened; ventral and dorsal surfaces of femora, tibiae and tarsi bordered with minute spiniform setae. Claws amber.

**Abdomen.** Wider at base and gradually narrowing caudad. Tergites mostly with uniform color pattern; tergites S1–S8 with dark, ovoid spots, these spots paler on S9, normally with two lateral dark stripes on each side, separated by pale spaces, S10 largely pale. Surface of all segments covered with minute setae and short hairs. Male gonapophyses pyramidal, pale, short, extending posteriorly to basal 0.27 of S10, ventral border with scattered, spiniform setae (Figure 1h). Male cerci short, globular, slightly concave ventrally (Figure 1i, j). Female gonapophyses exceeding posterior margin of S10 for 0.71 the length of S10, in ventral view lateral valves with long acute and parallel tips, ventral surface with 12–15 scattered, spiniform setae (Figure 1g).

Caudal gills foliaceous, with distinguishable pattern of dark spots on pale background, tip produced apically into tail-like filament. Margins of lateral gills (paraprocts) with a row of strong spiniform setae on basal 0.55, distal 0.45 bordered with long hairs. Median gill (epiproct) with a row of strong spiniform setae as in lateral ones, size proportion: 0.94 times the total length of lateral gills (without filament) (Figure 1k, l).

**Measurements (mm) ( $n = 3$ ).** Total length: 10.4–10.9; maximum width of head: 3.2–3.5; maximum length of head: 1.5–1.8; maximum width of prementum: 1.8–2.0; maximum length of prementum: 2.2–2.3; metafemur: 2.9–3.5.

### Diagnosis

The prominent ligula of *Argia medullaris* places into group I of Novelo-Gutiérrez (1992), species: *A. concinna*, *A. difficilis*, *A. emma*, *A. harknessi*, *A. insipida*, *A. moesta*, *A. oculata*, *A. oenea*, *A. tezpi*, *A. translata* and *A. ulmeca*; however, its ligula has the greatest basal width. The larva of *A. medullaris* more strongly resembles *A. extranea* (Hagen) and to a lesser extent, *A. anceps* Garrison, *A. ulmeca* Calvert, and *A. tonto* Calvert, in gill morphology, however. *Argia medullaris* differs from all these species by the parallel margins of the lateral gills, not observed in other species of the genus.

### Biology

*Argia medullaris* larvae inhabit inundated areas next to streams >2 m wide; this is a high mountain range species (1800–2100 m), from where other species of the genus are unknown.

### *Argia variegata* Förster, 1914

Figure 2a–o

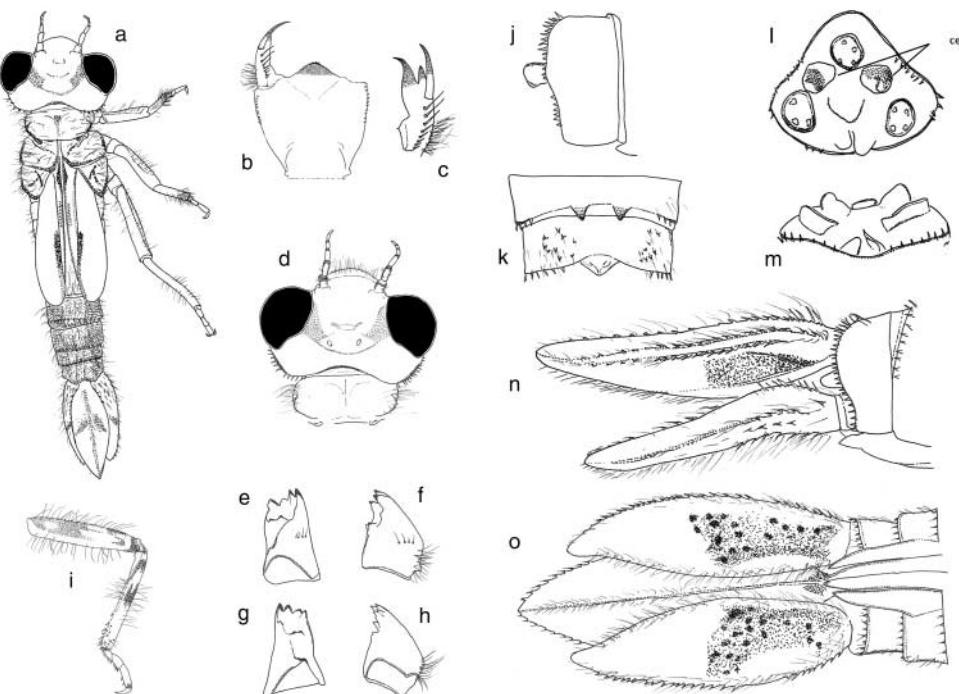


Figure 2. Details of morphology of the larva of *A. variegata*. (a) Dorsal aspect of F0 larva; (b) labium; (c) right labial palp, male, dorsal view; (d) detail of head and prothorax, dorsal view; (e) left mandible, ventral view; (f) left mandible, lateral view; (g) right mandible, ventral view; (h) right mandible, lateral view; (i) posterior leg, lateral view; (j) male gonapophyses, ventral view; (k) tip of male abdomen showing gonapophyses (gills detached), ventral view; (l) tip of male abdomen showing cerci (gills detached), posterior view (ce = cercus); (m) tip of male abdomen showing cerci (gills detached), ventral view; (n) distal portion of female abdomen showing gills, lateral view; (o) distal portion of female abdomen showing gills and gonapophyses, ventral view.

#### Material examined

1 exuvia ( $\sigma$ , emerged in the field), 5 ultimate stadium larvae ( $3\sigma$ ,  $2\varphi$ ), 8 early stadia ( $4\sigma$ ,  $4\varphi$ )  
COLOMBIA: Cundinamarca Dept, Guayabetal ( $4^{\circ} 26' 25''$  N,  $73^{\circ} 82' 61''$  W), alt. 1270 m, 1  $\varphi$ ,  
10 December 2007, L. A. Pérez leg. Deposited at (UARC), Barranquilla, Atlántico, Colombia.

#### Description

Larva mainly brown with distinctive color pattern on abdomen, legs and gills (Figure 2a).

**Head.** 1.49 times as wide as long, posterior margin slightly excavated. Cephalic lobes rounded, posterolateral margins bearing 20–25 spiniform setae. Labrum setose, brown, clypeus smooth, brown. Antenna 7-segmented, slightly shorter than head, all antennomeres with the distal portion dark; length ratio of antennomeres (from basal to apical): 0.69: 1.0: 0.79: 0.54: 0.36: 0.24: 0.18 (Figure 2d). Mandibles with molar teeth but lacking molar crest, with following formula: L  $1 + 2345$  y ab ( $5 > 2 > 1 > 4 > 3$ )/R  $1 + 2345$  y ab ( $5 > 4 > 3 > 2 > 1$ ) in both mandibles b > a (Figure 2e–h). Labium very short, pale hinge extending to posterior margin of procoxae, prementum 0.94 times as long as wide, with a row of 8–10 spiniform setae along distal half of lateral margins. Ligula prominent and pigmented, with closely set minute, claviform setae on distal margin (Figure 2b). Labial palp with 2 end hooks, which are shorter than movable hook, darker on distal half, the ventral hook the longest with tip acute and abruptly bent medially. Palp with 8 setae, the second seta nearest to movable hook the longest, remainder decreasing in length toward base, in ventral view with long hairs and spiniform setae (Figure 2c).

**Thorax.** Robust, largely brown with posterior and lateral margins of pro-, meso- and metathorax dark. Pronotal disc smooth, lateral margins strongly convex, dark and covered with spiniform setae and hairs, pterothorax robust and covered with abundant hairs. Wing sheaths brown, surpassing posterior margin of S6. Legs yellow, with dorsal surfaces brown, femora and tibiae with abundant long hairs. Femora robust, claws brown (Figure 2i).

**Abdomen.** Short, wider at base and gradually narrowing posteriorly. Tergites with lateral portion dark, forming two stripes along dorsum; surface of all segments covered with abundant long hairs. Male gonapophyses pyramidal, dark, very short, extending barely to anterior margin of S10, ventral border smooth (Figure 2j, k). Male cerci subquadrate in lateral view, in posterior view irregularly rounded with slightly sinuate ridge in ventral half, bluntly triangular in ventral view (Figure 2j, l, m). Female gonapophyses smooth, exceeding posterior margin of S10 for 0.87 the length of 10, in ventral view lateral valves with convergent tips.

Gills triquetral, in dorsal and ventral view with a distinguishable pattern of dark spots; tips rounded. Ventral margins of gills with spiniform setae and long hairs. Length of lateral gill approximately 0.94 of median gill (Figure 2n, o).

**Measurements (in mm) (n = 5).** Total length: 11.3–11.7; maximum width of head: 2.8–3.5; maximum length of head (without clypeus): 1.3–1.7; maximum width of prementum: 1.5–1.8; maximum length of prementum: 1.3–1.8; metafemur: 2.1–2.2.

#### Diagnosis

The larva of *A. variegata* falls into group II of Novelo-Gutiérrez (1992), with moderately prominent ligula. The most outstanding features are the unusual number of palpal setae (8), and the internal

hook of the labial palp with the tip abruptly bent. The number of palpal setae and the moderately prominent ligula do not support the relationship between the condition of ligula and number of palpal setae stated by Novelo-Gutiérrez (1992). *Argia variegata* resembles *A. extranea* by having the antenna shorter than head, and *A. immunda* (Hagen) by gills lacking an apical short, tail-like filament. The absence of setae and spines on male and female gonapophyses is apparently unique to *A. variegata*.

### Biology

*Argia variegata* shares its habitat with *A. fissa*, *Mesagrion leucorrhinum* Selys, and a still unidentified species of *Euthore*.

It is highly probable that the arrangement of the dorsoventrally compressed gills is a special adaptation to madicolous habits. The fact that the middle gill is longer than the lateral ones further adds to this hypothesis. This feature offers better hydrodynamic performance, and is known also in Megapodagrionidae larvae (i.e. *Heteropodagrion*, *Mesagrion*, *Sciotropis* and *Paraphlebia*), perhaps indicating evolutionary parallelism for living on rocky surfaces in the splash zone of small streams (Tennessee 2010).

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